

TAXONOMIC STUDIES ON THE *DISINAE*: 1. A REVISION OF THE GENUS *BROWNLEE* LINDL.

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ABSTRACT

The genus *Brownleea* is revised. Six species and two subspecies are recognized. Notes on the taxonomically important morphological characters are given. The habitat of each species is discussed and this is briefly related to the postulated evolutionary patterns in the genus. For each species a full description is given, and the variation, ecology and nomenclature is discussed.

UITTREKSEL

TAKSONOMIESE ONDERSOEK VAN DIE *DISINAE*: 1. 'n HERSIENING VAN DIE GENUS *BROWNLEE* LINDL.

Die genus *Brownleea* word hersien. Ses spesies en twee subspesies word erken. Aantekeninge oor die taksonomies belangrike morfologiese karakters word gegee. Die habitat van elke spesies word beskryf, en word in verband met die moontlike evolusionêre patrone in die genus bespreek. Vir elke spesie word 'n volle beskrywing gegee, en die variasie, ekologie en nomenklatuur word bespreek.

INTRODUCTION

The genus *Brownleea* Lindl. includes six species distributed from Knysna in the southern Cape to Cameroun in the west, northern Kenya in the north and Madagascar in the east. It is a tropical genus, with its centre of diversity in southern Africa. Although the genus is so widely distributed, only one species (*B. parviflora* Lindl.) can be described as being common.

Brownleea was described by Lindley in 1842 from two specimens (*B. parviflora* and *B. coerulea*) collected by the Rev. J. Brownlee. Harvey, to whom Brownlee had sent the material, suggested that the genus (which he rightly thought to be allied to *Disa*) be called after Brownlee (Lindley, 1842). All subsequent authors [with the exception of Reichenbach (1881)], maintained *Brownleea* as a distinct genus allied to *Disa* (Sonder, 1847; Bentham & Hooker, 1883; Pfitzer, 1889; Durand & Schinz, 1894; Kraenzlin, 1900; Schlechter, 1901; Rolfe, 1913; Thonner, 1915; Phillips, 1926; Dyer, 1976). To date a total of 20 names have been proposed in the genus, but no recent critical revision is available. Kraenzlin (1900) and Schlechter (1901) revised the genus when it was still insufficiently known; the majority of the taxa were proposed subsequent to these

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revisions. Rolfe (1913) dealt only with the South African taxa and did not take sufficient account of the range of variation found in taxa. Summerhayes (1966) critically revised the *Brownleea parviflora* group of species in tropical Africa.

In this study, species are understood to be biological entities (Linder, 1980). In the delimitation of taxa special attention is paid to eco-geographic data. This study is part of a general taxonomic study of the *Disinae*, and the relationships between *Brownleea* and its allies will be discussed in a later paper.

NOTES ON MORPHOLOGY

Tubers

Variation in the hair-covering of the tubers is correlated with the broad habitat type in which the species occurs. The forest taxa have villous tubers, as opposed to the pubescent tubers of the grassland taxa. However, this organ is frequently not collected, so that the data base is insufficient.

Leaves

The number of leaves per plant tends to be constant for each species. However, there are many exceptions and the range of number of leaves found is from one to three, so that this character is of limited use.

Leaf shape is correlated to the broad habitat type. The forest taxa have ovate to narrowly ovate leaves, compared to the narrowly lanceolate to linear leaves of the grassland taxa.

Inflorescence

In inflorescence shape, two directions of development can be traced if the subimbricate to imbricate spike of *B. parviflora* is taken as the starting point. One line leads to the capitate inflorescence of *B. galpinii* s.l., the other leads to the single flowers of *B. macroceras*, via the lax inflorescences of *B. recurvata*, *B. coerulea* and *B. maculata*. The second line is also associated with increase in flower size, and all the correlated changes in floral structure. As floral characters (i.e. the reproductive syndrome) are assumed to be more conservative than vegetative characters (the survival syndrome), inflorescence shape can be taken to reflect phylogenetic relationships.

Sepals

The sepals throughout the genus show little variation in shape, but they provide the best measurable indication of flower size. In *B. parviflora* the sepals do show a more or less square shape; this is interpreted as the effect of reduction in flower size.

Spur

Spur size and shape provides a very important character. Spur length essentially has two states: approximately as long as the dorsal sepal, or more than twice as long as the dorsal sepal. The spur can be sharply decurved, usually near the middle, or it can be gently decurved, or it can be straight. Three combinations of these characters exist in the genus. *B. parviflora*, *B. recurvata* and *B. maculata* have short sharply decurved spurs, *B. galpinii* s.l. has a short straight spur, and *B. macroceras* and *B. coerulea* have long gently decurved spurs.

Petals

Petal size is obviously correlated with sepal size. Petal shape is basically narrowly oblong—lanceolate. From this basic shape the pandurate shape with the upper margins crenulate found in *B. galpinii* ssp. *major* can be derived, via narrowly oblong-pandurate non-crenulate petals of *B. galpinii* ssp. *galpinii*. In *B. parviflora* the petals are oblong to square, possibly the result of reduction in flower size. The development line culminating in *B. macroceras* results essentially in the simplification of the petal into a lorate structure, with the development of anterior basal lobes as in *B. maculata*.

Gynostegium

Apart from size variation, there is no apparent directional development in the various structures of the gynostegium. In *B. parviflora* the whole structure is much reduced, and squat (possibly as a result of the size reduction). In *B. macroceras* with its large flowers, on the other hand, all the structures are slender. In *B. galpinii* s.l. the anther is curved over more than usual in the genus, so that the apex on the anther frequently touches the rostellum. In *B. coerulea* the central lobe of the rostellum is well developed, and almost as tall as the lateral lobes.

Discussion

These morphological data are used to group the taxa into species pairs, and to arrange the species pairs into a natural sequence or a cladogram (Fig. 1). This is the sequence which is compatible with the maximum number of evolutionary sequences for individual morphological characters.

PHYTOGEOGRAPHY, ECOLOGY AND SPECIATION

The genus *Brownleea* occurs in the Afro-montane Region (White, 1978) and the Austro-Afro-alpine Region (Killick, 1978). In these two chorological Regions essentially five vegetation types occur under well-drained to slightly damp conditions. The seven taxa in *Brownleea* occur in these five vegetation types (see Table 1). Only *B. recurvata* and *B. macroceras* transgress into neighbouring

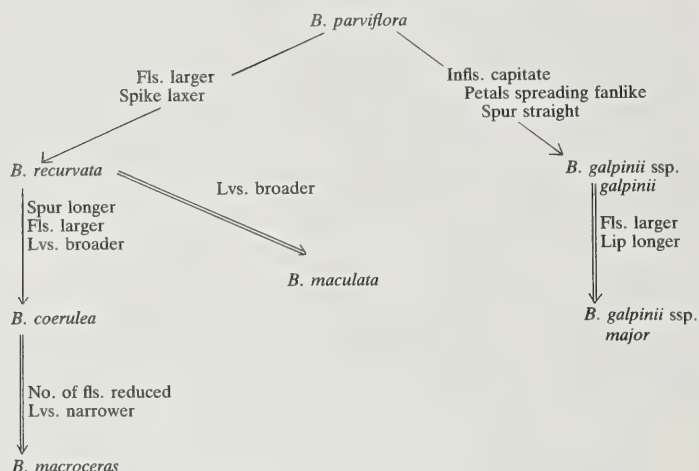


FIG. 1.

Postulated evolutionary relations (cladogram) based on morphological relations. The notes indicate which characters change from one species to the other, the arrows indicate the direction of the change. Single arrows indicate a weak relationship, double arrows a close relationship.

TABLE 1.
Chorological Regions, vegetation types and the species of *Brownleea*.

Chorological Region	Vegetation Type	Species
Austro-afro-alpine	Alpine Belt	<i>B. macroceras</i>
	Subalpine Belt	<i>B. macroceras</i> <i>B. galpinii</i> ssp. <i>major</i>
Afro-montane	Secondary Fynbos	<i>B. recurvata</i>
	Secondary Grassland	<i>B. galpinii</i> ssp. <i>galpinii</i> <i>B. parviflora</i>
	Montane Forest	<i>B. coerulea</i>
		<i>B. maculata</i>

vegetation types. *B. recurvata*, which generally occurs in the fynbos in areas where the climax is probably montane forest, transgresses at the eastern end of its distribution into secondary montane grassland. *B. macroceras* transgresses at the southern end of its distribution into the fynbos of the subalpine belt (Killick,

1978), which is probably the subclimax of montane forests, whereas the bulk of its distribution range falls in the alpine belt in the high Drakensberg. Both these transgressions occur in the overlap zones with the species from which the transgressing species is presumed to have been derived. In the case of *B. macroceras*, the transgressor shows its maximum amount of population variation in this zone.

The only two species which appear to be sympatric in the same broad vegetation zone are *B. parviflora* and *B. galpinii* s.l. Whether they occur in exactly the same habitat has not been determined. On Mont-aux-Sources, where the two species were collected in close proximity, *B. parviflora* occurred in shallow, well-drained rocky soil, while *B. galpinii* ssp. *major* grew in deeper soil in seasonal seepages (Linder 2074 and Linder 2073 respectively).

On morphological grounds, two very closely related species pairs can be postulated in the genus (*B. macroceras*/*B. coerulea* and *B. recurvata*/*B. maculata*). In both cases, the single most important differential character is the leaf shape. In both cases, one member of the pair inhabits montane forest (*B. coerulea* south of the Limpopo and in Madagascar and *B. maculata* north of the Limpopo), while the other member occurs in full sunlight (*B. recurvata* in the fynbos of the Eastern Cape, and *B. macroceras* under alpine and subalpine conditions in the Eastern Cape and Natal). The two subspecies of the polytypic *B. galpinii* separate environmentally into an alpine group (subspecies *major*) and a montane grassland group (subspecies *galpinii*).

By investigating the eco-geographic differences between closely related species (on morphological evidence, see Fig. 1), the factor(s) that may have caused the differentiation that led to the speciation can be postulated. In all the species pairs in *Brownleea* ecological differences between the taxa appear to be more important than geographic isolation. If geographic isolation were important, populations of the same species that are effectively isolated (such as *B. parviflora* and *B. coerulea*, both with an Africa-Madagascar disjunction) should have differentiated into distinct taxa (i.e. speciated). However, if ecological conditions were important, each taxon should only occur in one habitat type. This is generally found to be the case (Table 1).

The postulated scheme of evolution implies that dispersion must occur relatively easily in this genus. This assumption is borne out by the Afro-Madagascan distribution of two species, and by the extra-ordinary outliers of *B. parviflora* on the Cameroon Mountain and in the north of Kenya, with the northern most part of the continuous distribution being in the south of Tanzania (Fig. 10). Although it is possible that this is a relic distribution, the absence of this species from the highlands of Kenya, as well as the relatively specialized nature (and therefore probably evolutionary recent nature) of the genus, argue that these are new colonizations. It is thus considered possible that the prototype of *B. maculata* could have been derived from *B. recurvata*, although the latter occurs more than 1 000 km to the south.

TAXONOMY

Brownleea Lindl.

Brownleea Harv. ex Lindl. in Hook. Lond. J. Bot. 1: 16 (1842).

Leaves 1–3(–5), scattered on the stem, linear to ovate, usually more or less plicate with emergent veins, nitid; flowers white to mauve; dorsal sepal acute to acuminate, usually lanceolate, 3–13 mm tall, spur horizontal at the base; lateral sepals flat, oblique, narrowly elliptical to oblong, acute, 3–18 mm long; petals erect, fused to the dorsal sepal, more or less oblong to lanceolate or pandurate; lip minute, erect in front of the stigma; rostellum lateral lobes erect, lorate, bearing the viscidia at their apexes; caudicles almost as long as the pollen-masses, anther usually apically upcurved; stigma sessile.

Tubers more or less testicular, pubescent to woolly, up to 50 mm long. *Plants* mostly erect, slender, 50–600 mm tall, scape generally nitid, the base rarely with a sheath of old leaf fibres; basal sheath(s) pale brown, often more or less mucronate, obtuse to acute, up to 150 mm long. *Leaves* 1–3 (–5), scattered on the stem, erect to spreading, linear to ovate, acute to sub-acuminate, the blade up to 220 mm long, usually nitid, more or less plicate, with the veins somewhat prominent. *Inflorescence* a capitate to lax spike; flowers single to numerous, from c. 5 mm to 30 mm in diameter, white to mauve or pale with darker mauve spots; bracts shorter than to much longer than the ovary, acuminate, green, erect. *Dorsal sepal* odd, more or less lanceolate, acuminate, falcate in side view, the apex often reflexed, 3–13 mm long; spur horizontal at the base, then either short and sharply downcurved, or short and straight, or up to 50 mm long, slender and gradually decurved. *Lateral sepals* flat, generally oblique, narrowly elliptical, rarely oblong, acute, 3–18 mm long. *Petals* fused by the backs to the dorsal sepal, oblanceolate to oblong to almost pandurate; occasionally with a basal anticous tooth, the upper margin flat or crenulate, apex acute or rounded. *Lip* minute, erect from a broad short base in front of the stigma, 0.1–2 mm long. *Rostellum* tall, erect; lateral lobes more or less lorate, concave, bearing the viscidia at their apexes, central lobe a small fleshy body at the base of the lateral lobes, except in *B. coerulea*, where it is finger-like; staminodes up to as large as the lateral lobes. *Anther* horizontal, the apex generally upcurved, caudicles almost as long as the 2 pollen-masses; viscidia two, globular, separate. Stigma sessile at the base of the rostellum.

Lindley described the genus in 1842 from two species (*B. parviflora* and *B. coerulea*), but failed to select one as the type of the genus. The holotypes of both species are still extant in the Lindleyan herbarium at Kew. *B. parviflora* Lindl. is here selected as the lectotype of the genus.

Lectotype: Brownleea parviflora Lindl.

KEY TO THE SPECIES

1. Flowers in an apical head, or at least strongly apically congested, petals expanded apically, margins crenulate, patent.

2. Lateral sepals 6–7 mm long, lip less than 1,5 mm long 6a. *galpinii* ssp. *galpinii*
 2'. Lateral sepals (6,5–)8–10 mm long, lip more than 1,7 mm long 6b. *galpinii* ssp. *major*
- 1'. Flowers in a lax to subimbricate spike, petals not apically expanded, not patent, margins not crenulate.
3. Spur more than twice as long as the dorsal sepal, straight or gradually decurved.
 4. Leaves 1(–3), narrowly lanceolate, less than 10 mm wide, plants with 1–3 (–5) flowers 1. *macroceras*
 4'. Leaves 3, lanceolate, wider than 10 mm, plants with (5–)6–15 flowers 2. *coerulea*
- 3'. Spur less than twice as long as the dorsal sepal, sharply and geniculate-decurved.
 5. Dorsal sepal less than 6 mm long, flowers in dense to rarely lax many-flowered cylindrical spikes 5. *parviflora*
 5'. Dorsal sepal more than 5 mm long, flowers in lax several-flowered spikes.
 6. Leaves linear to narrowly lanceolate, width less than 10 mm 3. *recurvata*
 6'. Leaves lanceolate to narrowly ovate, width more than 10 mm 4. *maculata*

1. *Brownleea macroceras* Sond. in *Linnaea* **19**: 106 (1847). Type: Eastern Cape, Stockenstrom Division, Katriviersberg, 5 000 to 6 000 feet, above forest, March, Ecklon and Zeyher s.n. (S!, holotype; K!, W!).

Disa macroceras (Sond.) Reichb.f., *Otia Bot. Hamb.* **2**: 119 (1881).

Brownleea monophyllum Schltr. in *Bot. Jahrb.* **31**: 307 (1901). Type: Grassland on the summit of Drakensberg, altitude 9 000 to 10 000 feet, Feb. 1893, Thode 52 (B†, holotype; K!).

Brownleea coerulea sensu Bolus in *J. Linn. Soc.* **25**: 204 (1889) as to *B. macroceras*.

Icon: *Fl. Pl. S. Afr.* **19**: t.740 (1939).

Flowers large (lateral sepal (10–)13–18 mm long), spurs long [(15–)25–40 mm], 1(–6) flowers per inflorescence and with 1(–3) narrowly lanceolate leaves.

Tubers c. 15 mm in diameter. *Plants* erect or upcurved, (50–)100–300(–500) mm tall; basal sheath hyaline to pale brown, obtuse and apiculate, ribbed and with dark-brown muricate patches, (20–)40–80 mm long. *Leaves* 1(–3), scattered on the scape, shortly sheathing at the base, the blade usually narrowly lanceolate, acute to very acute, spreading, shallowly conduplicate, 60–80(–120) mm long and 4–10(–30) mm wide. *Inflorescence* 1(–6) flowered; ovary slender, up to 25 mm long; bracts up to 8 mm wide at the base, acuminate, as long as or shorter than the ovary, the midvein prominent; flowers up to 30 mm in diameter, facing out horizontally; lateral sepals and petals pale mauve to almost white, dorsal sepal muddy mauve, apex of the spur purplish or green, base of the petals purple, rostellum white and stigma blue-mauve. *Dorsal sepal* galeate, narrowly oblong to lorate or lanceolate, laterally flattened, the apex reflexed, galea 10–13 mm tall, c. 2–3 mm wide and 3–6 mm deep; spur slender cylindrical, from a short conical base, horizontal at the base and at length somewhat decurved, apically subclavate, obtuse; (15–)25–40 mm long. *Lateral sepals* oblique, narrowly elliptical, acute, flat, spreading forwards and down, (10–)

13–18 mm long and 4–6 mm wide. *Petals* oblanceolate to narrowly obovate, suboblique, acute, facing forwards, 10–14 mm long and 4–5 mm wide. *Lip* linear, ascending in front of the stigma, c. 2 mm long. *Rostellum* erect, 3–5 mm tall, lateral lobes well developed, shallowly concave, staminodes c. 1 mm in diameter; anther c. 3 mm long, the apex upcurved, viscidia spherical; stigma c. 2,5 mm in diameter, sessile at the base of the rostellum. (Fig. 2).

B. macroceras was described by Sonder in 1847 from material collected by Ecklon and Zeyher from near the southern end of the distribution range of this species, on the Katriviersberg. The specimens are 2(–3) leaved, and the flowers are somewhat smaller than average. Bolus (1889, 1896), Kraenzlin (1900) and Schlechter (1901) included *B. macroceras* in *B. coerulea* Lindl. No reasons are given, but as will be shown below, ignorance of the morphological and ecological ranges of *B. macroceras* and *B. coerulea* probably caused this confusion.

In 1901 Schlechter described *B. monophyllum*. He cites as type a Thode specimen, collected from the Drakensberg. This was probably from the Montaux-Sources area, where Thode is known to have collected (Killick, 1977). Schlechter compared the new species to *B. coerulea* and *B. madagascarica*, to which it is doubtlessly allied. He considered that the single leaf found on the type specimen is an important differential character: “a character, that should not be underestimated in *Brownleea*”. However, field studies have shown that this character is variable in natural populations. Schlechter’s treatment was followed by Rolfe (1913), Bolus (1939) and Jacot Guillarmod (1971). Bolus (1939) noted that: “Probably, when ample living material is available for study, the two species (*B. monophyllum* and *B. macroceras*) will prove to be identical”.

VARIATION

A geographic gradient can be detected in the variation patterns. In the northern part of the distribution range, the plants tend to be smaller, more frequently single-flowered with a single leaf. The flowers also tend to be larger. In the Katberg (southern end of the distribution), individuals with up to 6 flowers and 3 leaves occasionally occur, but the flowers tend to be smaller. Within populations, the range of variation also increases from the north to the south, and populations on the Katberg (*Linder 2111*) range in size from 400 mm tall (in wet shaded seepage conditions) to less than 100 mm tall on dry ledges with shallow soils.

ECOLOGY AND PHYTOGEOGRAPHY

B. macroceras is distributed from Harrismith in the Orange Free State, along the Drakensberg to the Winterberg (Queenstown Division) in the Eastern Cape. In the north it occurs above 2 700 m, and in the south above 1 800 m. Throughout its range it is generally associated with rock outcrops, where it occurs on rock ledges and in shallow rocky soil.

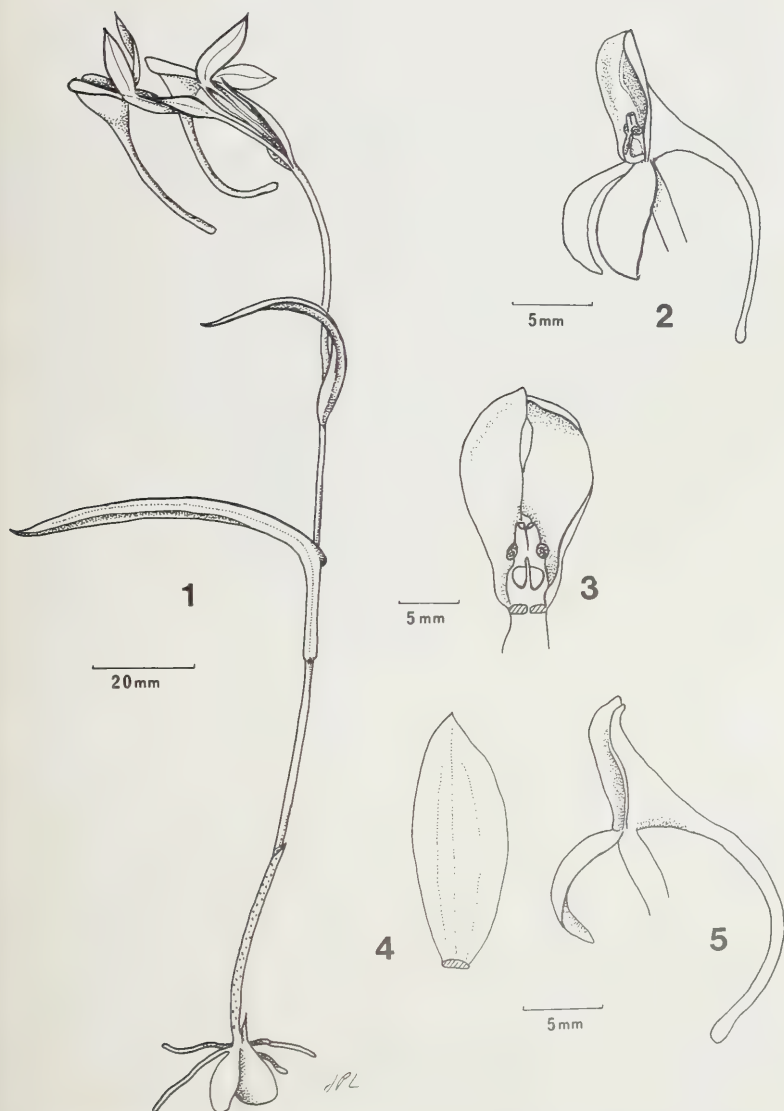


FIG. 2.

B. macroceras. 1. Whole plant (Linder 2075). 2-5. Floral structure (Linder 949); 2. Side view of flower; 3. Column, petals and lip; 4. Lateral sepal; 5. Spur and dorsal sepal.

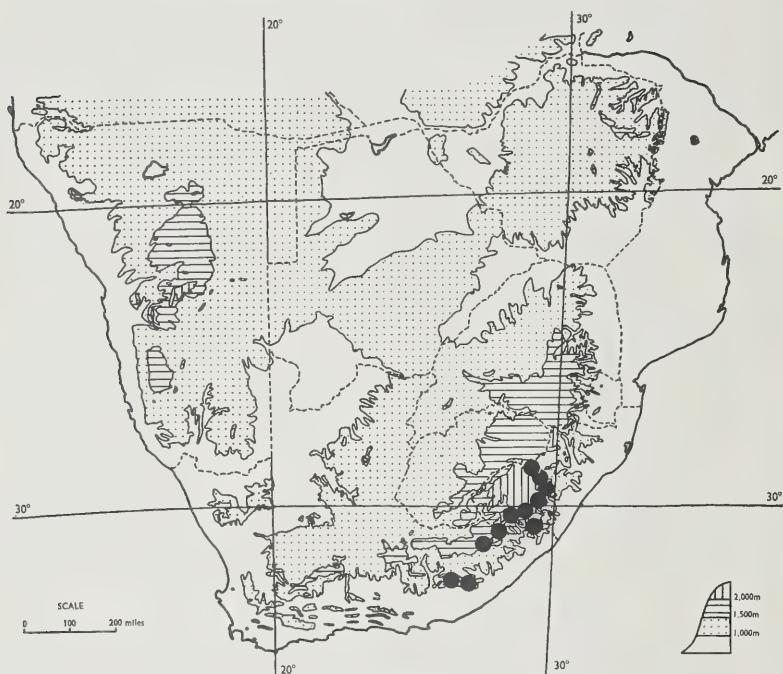


FIG. 3.
Distribution of *B. macroceras*.

In the Drakensberg *B. macroceras* occurs in the alpine belt, in *Danthonia*–*Festuca*–*Pentstemon* grassland (Killick, 1963; West, 1951). In the Eastern Cape it grows in depauperate macchia (Story, 1951). In the Drakensberg this species is associated with basalt rock or derived soils, while in the Eastern Cape it is associated with dolerite. The climate throughout the area is severe, with snow in winter, and frequent mist in summer. In the north almost all rain falls in summer, but in the Eastern Cape up to 30 % of the rain falls in winter (Story, 1951). Recorded rainfall in the Drakensberg is 1 609 mm p.a. at the Organ Pipes Pass (Cathedral Peaks Area) (Killick, 1963) and 1 271 mm p.a. in the Mont-aux-Sources area at c. 3000 m (Herbst & Roberts, 1974). In the Hogsback area rainfall is about 1 100 mm p.a. (Story, 1951).

This appears to be the only species that is scented.

Generally the plants are common in suitable habitats, but dense populations

are not formed. Flowering occurs from late February until the beginning of April.

REPRESENTATIVE COLLECTIONS

Lesotho, between Indumeni Dome and Castle Buttress, frequent in alpine grassland, flowers light purple, 6.II.1949, *Killick 2319* (PRE, BM, K); Eastern Cape, Maclear, ascent to Naudés Nek, c. 2 500 m, wet scree slopes, flowers white to deep lilac, 19.II.1971, *Hilliard & Burt* (NU, K); Eastern Cape, King William's Town, Gaikas Kop, 1 800 m, very common in moist mossy cracks in cliffs, flowers very pale mauve to almost white, 14.II.1977, *Linder 1055* (BOL).

2. *Brownleea coerulea* Harv. ex Lindl. in Hook. Lond. J. Bot. 1: 16 (1842). Type: Eastern Cape Province, near King William's Town, among trees, March 1841, *Brownlee s.n.* (K!, holotype).

Disa coerulea (Harv. ex Lindl.) Reichb.f., Otia Bot. Hamb. 2: 119 (1881).

Brownleea madagascariensis Ridley in J. Linn. Soc. 22: 126 (1885). Type: Madagascar, Imerina, *Fox s.n.* (K!, holotype).

Brownleea nelsonii Rolfe in Fl. Cap. 5, 3:262 (1913). Type: Transvaal, *Nelson 16* (K!, holotype).

Brownleea woodii Rolfe in Fl. Cap. 5, 3: 262 (1913). Syntypes: Natal, in stony bush near Murchison, 2 000 feet, *Wood 1982, 3179* (K!, syntypes).

Icones: Curtis's Bot. Mag. t.7309 (1893). H. Bolus, Icones Orch. Austro-Afr. 1: t.40 (1896). Fl. Pl. S. Afr. 18: t.702 (1938).

Flowers large (lateral sepal 8–12 mm long); spur long, slender (13–26 mm long); inflorescence subimbricate 3–15–30-flowered; leaf narrowly ovate to rarely narrowly lanceolate (wider than 10 mm).

Tubers usually woolly, spreading, 15–40 mm long, 10–20 mm in diameter. *Plants* erect, 100–350–600 mm tall, basal sheaths usually two, the outer often, and occasionally both, lost, generally obtuse, apiculate, the inner up to 140 mm long, the veins emergent and the surface muricate. *Leaves* (2–)3(–4), scattered on the scape, shortly sheathing at the base, the blade spreading, narrowly ovate, rarely narrowly lanceolate, subacuminate, subcordate at the base, up to 220 mm long and (15–)40(–65) mm wide, the central vein somewhat emergent below. Inflorescence subimbricate, oblong, 30–60–100 mm long and 3–15–30-flowered; ovary 10–20 mm long, generally the longest near the base of the inflorescence; bracts narrowly lanceolate, very acute to acuminate, overtopping the flowers at the base of the inflorescence, shorter than the ovaries near the apex; flowers c. 20 mm in diameter, spreading horizontally, mauve, often with deep purple dots on the galea. *Dorsal sepal* galeate, lanceolate in front view, falcate in side view, acuminate, 8–8.5–10 mm long, galea c. 3 mm deep and 1 mm wide; spur slender cylindrical from a shortly conical base, horizontal at the base, the apex subclavate, frequently decurved, spur 13–20–26 mm long. *Lateral sepals* oblique, nar-

rowly elliptical, acute to subacute, spreading with the inner margins parallel, 8–9.5–13 mm long. *Petals* narrowly oblong from a slender basal limb, apically more or less truncate, the rear base of the blade toothed, petal more or less as long as the dorsal sepal, the blade frequently conduplicate, the basal limb attached to the rostellum. *Lip* minute, linear, erect in front of the stigma, c. 1 mm long. *Rostellum* angled backwards, c. 2 mm tall, lateral lobes shallowly grooved, truncate, central lobe finger-like, as tall as the lateral lobes, acute, staminodes c. 1 mm in diameter, pearly; anther c. 2 mm long, strongly up-curved; stigma vertical on the base of the rostellum.

Brownleea coerulea has generally been recognized as a distinct species. Bolus (1889) included *B. macroceras* Sond. in *B. coerulea*, and was followed by Kraenzlin (1900) and Schlechter (1901).

Brownleea madagascariensis was described by Ridley, who noted its similarity to *B. coerulea*. As a differentiating character he mentions that the petals are fused to the galea by their backs, and not by the inner margins as would be expected, but this is characteristic for the whole genus, a fact Ridley seems to have been unaware of. Kraenzlin (1900) and Schlechter (1901) maintained it as a distinct species, although Schlechter remarked that only the remarkable geographic distribution and some (undefined) differences in the galea separated it from *B. coerulea*.

Both *B. nelsonii* and *B. woodii* were separated from *B. coerulea* on leaf width. The two syntypes of *B. woodii* were collected on the same day (30.IV.1884) at Murchison—they could be the same collection. Rolfe stated that it is "Distinguished from *B. coerulea* Harv. by its narrower leaves and smaller, differently coloured flowers". The leaf width falls at the lower extreme of the range recorded in the species, but flower size and colour do not appear to be exceptional. There appears to be even less difference between *B. nelsonii* and *B. coerulea*. Flower structure is identical. The leaves of the type are folded, making measurement difficult, yet Rolfe uses leaf width as the key character to separate this species from *B. coerulea*.

VARIATION

The variation in leaf width follows geographical patterns (Fig. 4). Collections from the Eastern Cape tend to have broader leaves (35–60 mm wide) than collections from Natal (25–45 mm wide). Collections from the Transvaal straddle the whole range. Not enough material is available for a statistical analysis.

ECOLOGY AND PHYTOGEOGRAPHY

B. coerulea has a remarkable disjunct distribution: in South Africa it is distributed from King William's Town in the south along the montane or sub-montane forest belt to Pilgrims Rest in the Eastern Transvaal, and it also occurs on the

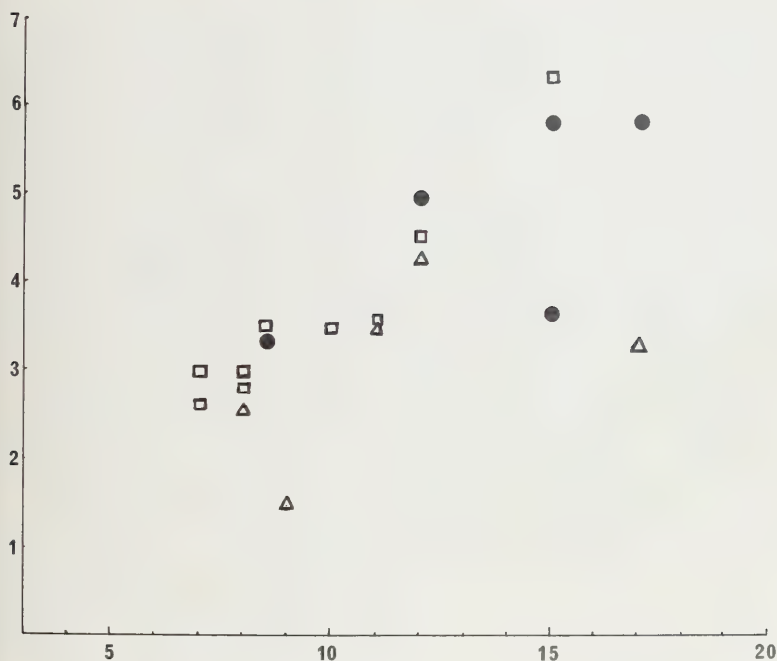


FIG. 4.

Variation in the leaf width of *B. coerulea*. ● = Eastern Cape; △ = Natal; □ = Transvaal and Swaziland.

central mountains of Madagascar. Throughout its range this species occurs in shaded habitats, usually in forests or forest patches, growing on old tree trunks, in moss, and on rock ledges.

The climate over its distribution range is temperate to sub-tropical. Rainfall over the whole area is above 1 000 mm p.a. (W.B. 20; Jackson, 1961), and most of the rain falls in the summer months. Snow does not occur (Koechlin, 1972).

The altitudinal range of this species in the north (Pilgrims Rest) is from 1 000 to 1 500 m, whereas in the south the species occurs at sea-level. Flowering time is from February to April, but in Madagascar the flowering season is somewhat later, from March to June.

REPRESENTATIVE COLLECTIONS

Swaziland, Mbabane, Dalriach Plantation 1 350 m, 5.III.1957, *Compton* 26730 (PRE, NBG); Natal, Port Shepstone, Izotsha Falls, in shade of vegetation

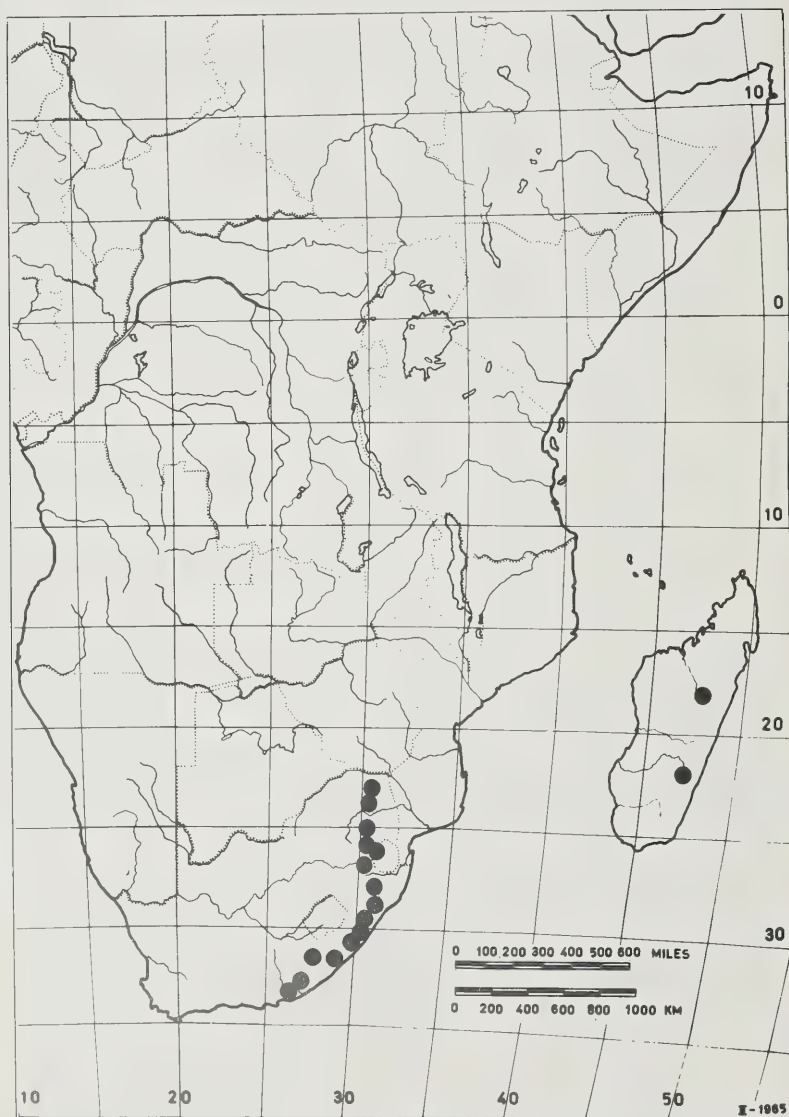


FIG. 5.
Distribution of *Brownleea coerulea*.

at edge of falls, 22.II.1964, *Hilliard 2749* (NU); Transvaal, Barberton, Ngomangoma Falls, shaded ledges, flowers purple lilac with black spots on the hood, 1.IV.1975, *Stirton 1762* (PRE); Eastern Cape, Pirie Forest, damp shady places, 1 000–1 200 m, IV.1888, *Scott-Elliot 913* (BM, K); Madagascar, Ambatowy, near Tananarive, woodland, IV.1957, *Bosser 11085* (P).

3. ***Brownleea recurvata*** Sond. in *Linnaea* **19**: 107 (1847). Type: Eastern Cape Province, Uitenhage, along Elandsriver, March, *Ecklon & Zeyher s.n.* (S!, holotype; W!).

Disa recurvata (Sond.) Reichb.f., *Otia Bot. Hamb.* **2**: 119 (1881).

Brownleea natalensis Rolfe in *Fl. Cap.* **5**, 3: 262 (1913). Type: Natal, near Byrne, *Wood 3177* (K!, holotype).

Icones: Bolus, *Icones Orch. Austro-Afr.* **1**: t.41 (1896). Harvey, *Thes. Cap.* **2**: t.104 (1863).

Flowers medium-sized (lateral sepal 8–11 mm long); spur sharply decurved, 5–10 mm long; inflorescence a lax spike; leaves linear to narrowly lanceolate, 8(–14) mm long.

Tubers hirsute, 10–30 mm long and 5–10 mm in diameter. *Plant* erect, occasionally subflexuose, (200–)400(–500) mm tall; basal sheaths two, the outer obtuse, 20–40 mm long, often lost; the inner up to 100 mm long, acuminate; both sheaths with prominent veins, often muricate. *Leaves* 2(–3), scattered on the scape, shortly sheathing at the base, the lower leaf the largest, up to 200 mm long and 8(–14) mm wide, linear, lanceolate, very acute to acuminate, erect, veins prominent below. *Inflorescence* lax, up to 150 mm long, (3–)12–17-flowered; ovary 10–15 mm long; bracts lanceolate, acuminate, usually slightly overtopping the flowers; 15–25 mm long, the lower bracts longer than the upper; flowers c. 10 mm in diameter, horizontal, white to soft pink, with a couple of red-brown-purple spots on the upper petal lobe, spur darker pink than the flowers. *Dorsal sepal* galeate, lanceolate, falcate in side view, acuminate, the apex occasionally reflexed, 7–8, 7–12 mm long, galea c. 3 mm wide and 3 mm deep; spur cylindrical occasionally somewhat clavate, horizontal at the base and usually decurved from the middle, 5–7, 3–10 mm long. *Lateral sepals* sub-oblique, narrowly elliptical, very acute, spreading forwards, 8–8, 9–11 mm long. *Petals* suboblique, narrowly oblong, somewhat shorter than the dorsal sepal, somewhat broader towards the base, a small basal anticus lobe flanking the stigma. *Lip* linear, c. 1 mm long, erect in front of the stigma. *Rostellum* erect, c. 3 mm tall, lateral lobes lorate, truncate, concave, staminodes c. 1 mm tall, almost reaching the tip of the lateral lobes; anther c. 3 mm long, the apex upcurved; stigma vertical, sessile at the base of the rostellum. (Fig. 6).

B. recurvata has been recognized as a distinct taxon by all authors that have dealt with this genus.

Rolfe did not indicate why he separated *B. natalensis*, nor to which species it

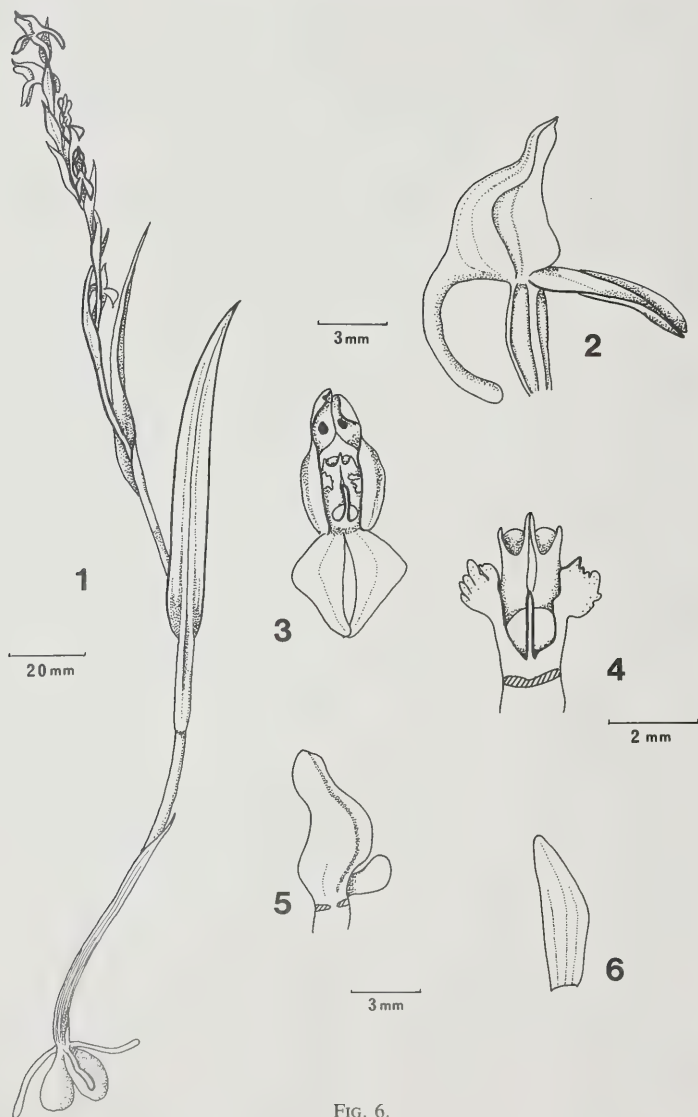


FIG. 6.

B. recurvata. 1. Whole plant (Linder 2094). 2-6. Floral structure (Batten); 2. Side view of flowers; 3. Front view of flower; 4. Rostellum structure; 5. Petal structure; 6. Lateral sepal in two dimensions.

was allied. He placed it near *B. recurvata*, from which he separated it in his key by the spotted flowers and the crenate petals. Investigation of the type specimen revealed that the spots are probably necrotic (this is apart from the spots normally found in this species on the petals). The petals are not markedly crenate—certainly not sufficiently to warrant specific distinction.

ECOLOGY AND PHYTOGEOGRAPHY

B. recurvata extends from Knysna in the Southern Cape Province to East Griqualand. In this area it occurs in well-drained localities, often in pebbly soils, or rarely in damp localities. In the south it is associated with fynbos vegetation and in East Griqualand it has been collected in *Themeda triandra* grassland. In general it occurs below 1 500 m altitude.

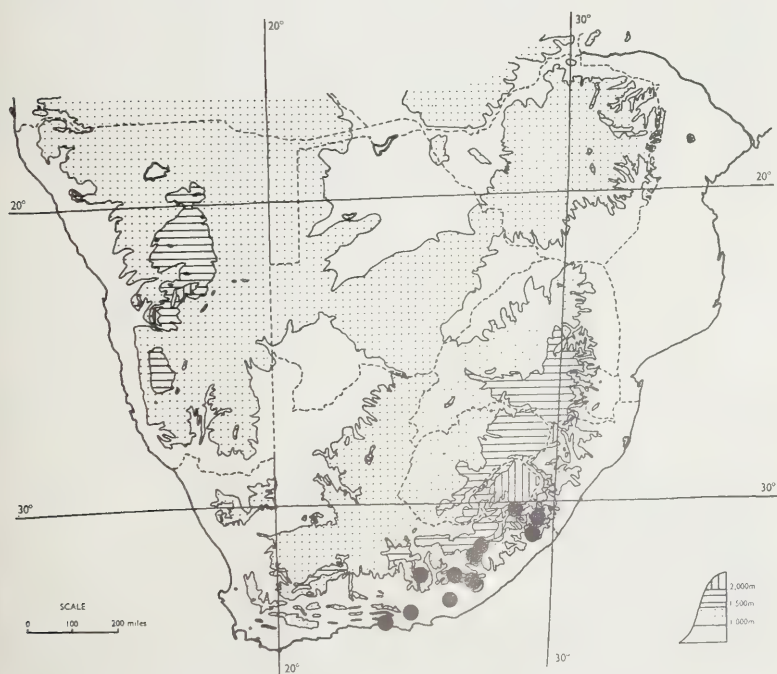


FIG. 7.
Distribution of *B. recurvata*.

Although the climate over the whole distribution range is fairly temperate, it changes from an all-year rainfall regime in the south to a summer rainfall regime in the north-east. In the Knysna area rainfall is about 1 100 mm p.a., fairly evenly distributed over the whole year (W.B. 20, 35). Over the rest of the distribution range the rainfall is about 700 mm p.a., concentrated in the summer months. In East Griqualand 70 % of the rain falls between November and April.

Populations tend to be scattered in suitable habitats, and no dense stands of this species have been seen. Flowering occurs from the end of February to the beginning of April.

REPRESENTATIVE COLLECTIONS

Eastern Cape, mountain slopes above Grahamstown, III.1892, *Glass* in *MacOwan & Bolus 1377* (BOL, BM, K, SAM, ZT, P, G, UPS, W); Transkei, Tabankulu, steep rocky grassy hillside, flowers white to very pale pink, spotted purple inside the hood, 16.II.1971, *Hilliard & Burt 6508* (NU, PRE, K); Southern Cape Province, Tzitzikamma, Ratels Bosch Flats, 180 m, *Fourcade 554* (BOL).

4. *Brownleea maculata* Cribb in Kew Bull. 32: 147 (1977). Type: Zimbabwe, Chimanimani Mountains, 6.VI.1949, *Wild 2913* (K!, holotype; SRGH!).

Icon: Kew Bull. 32: 148 (1977).

Flowers medium-sized (lateral sepals 6–7 mm long); spur decurved in the middle, 6–8 mm long; inflorescence a severally flowered lax spike; leaves lanceolate to narrowly ovate.

Tubers c. 35 mm long and 15 mm in diameter, densely villous, not well known. *Plant* 150–350 mm tall, often somewhat flexuose; basal sheath fibrous, acute, up to 100 mm long, frequently lost. Leaves (2–)3, lanceolate to narrowly ovate, acute to acuminate, shortly sheathing at the base, the blade somewhat ascending, up to 110 mm long and 40 mm wide, the veins emergent. *Inflorescence* lax to subimbricate, several to many-flowered, up to 100 mm long; ovary slender, 10–15 mm long; bracts lanceolate to narrowly lanceolate, acuminate, the lowest bract frequently leaf-like, up to 45 mm long, the remainder usually less than 20 mm long; flowers c. 8 mm in diameter, horizontal, sepal mauve-purple, petals white, laterals and petals purple-spotted and striped. *Dorsal sepal* galeate; galea narrowly ovate, acute, falcate in side view, 6–7 mm tall, 2.5 mm wide and 1.5–2 mm deep; spur cylindrical from a short conical base, soon sharply decurved to recurved, apex subclavate, rounded, 6–8 mm long and 0.8 mm in diameter. *Lateral sepals* oblique, narrowly elliptical, acute, spreading forwards, flat, 6–7 mm long and 2–3 mm wide. *Petals* erect, obovate, subacute, with a large basal anticus tooth flanking the stigma, c. 6 mm long and 1.5–2 mm wide. *Lip* minute, erect, c. 2.8 mm long and 0.5 mm wide. *Rostellum* c. 2.5 mm tall, lateral lobes tall, concave, staminodes large; anther c. 2 mm long, sharply up-curved from a horizontal base; stigma vertical.

ECOLOGY AND PHYTOGEOGRAPHY

B. maculata occurs in forests and shaded conditions in the Eastern Highlands of Zimbabwe and on Mt. Mlanje in Malawi. It has not been recorded from altitudes below 1 500 m. The most common substrate is old rotting tree-trunks, although one collection has been made from quartzite rock in deep shade. It occurs both in *Philippia* woodland, as well as other types of woodland (i.e. *Wid-dringtonia* forest on Mt. Mlanje).

The climate is generally equitable, almost temperate, and temperature extremes are not severe. Rainfall on Mt. Mlanje ranges from 1 710 mm p.a. to 2 934 mm p.a. (Chapman, 1962), and in Zimbabwe the rainfall is c. 1 400 mm p.a. (Jackson, 1961).

The flowering time is from March to June, with one record from Mt. Mlanje from August.

REPRESENTATIVE COLLECTIONS

Malawi, Mt. Mlanje, Sumbani Plateau, 2 000 m, shade of *Philippia* near stream, flowers purple with darker spots, 12.V.1963, *Wild* 6230 (BOL, SRGH, K); Zimbabwe, Chimanimani Mountains, between Bundi Plain and Upper Valley, shade of small forest patch by stream, flowers mauve with darker spots, 9.IV.1967, *Drummond* 9130 (SRGH).

5. *Brownleea parviflora* Harv. ex Lindl. in Hook. Lond. J. Bot. **1**: 16 (1842). Type: Eastern Cape Province, near King William's Town, 1841, *Brownlee s.n.* (K!, holotype).

Disa parviflora (Harv. ex Lindl.) Reichb.f., Otia Bot. Hamb. **2**: 119 (1881).

Disa alpina Hook.f. in J. Linn. Soc. **7**: 220 (1864). Type: Cameroon Mountain, November, *Mann s.n.* (K!, holotype; W!).

Brownleea alpina (Hook.f.) N.E. Br. in Fl. Trop. Afr. **7**: 287 (1898).

Disa preussii Kraenzl. in Bot. Jahrb. **17**: 64 (1863). Type: Cameroun, grassy area of mountains west of Buea, September, *Preuss* 973 (B†, holotype; K!).

Disa apetalata Kraenzl. in Bot. Jahrb. **22**: 21 (1896). Type: Tanzania, Kilimanjaro, Useri, *Volkens* 1969 (B†, holotype).

Brownleea apetalata (Kraenzl.) N.E. Br. in Fl. Trop. Afr. **7**: 287 (1898).

Brownleea gracilis Schltr. in Bot. Jahrb. **53**: 545 (1915). Type: Tanzania, montane meadows on Rungwe, December 1912, *Stolz* 1178; same locality, April 1913, *Stolz* 1981; meadows at Mpolato, March 1914, *Stolz* 2580 (B†; syntypes, K!, W!, G!, C!, S!, P!, Z!, BM!, PRE!, BR!).

Brownleea perrieri Schltr. in Fedde Repert. Beih. **33**: 102 (1924a). Type: Madagascar, Massif d'Andringitra, April 1921, *De la Bathie* 13752; Rocailles de la Manondona, April 1912, *Perrier de la Bathie* 11881 (P!; syntypes).

Brownleea transvaalensis Schltr. in Ann. Transv. Mus. **10**: 250 (1924). Types: Transvaal, Houtboschberg, *Schlechter* 4711 (B†, syntype; Z! K!), Transvaal, Bar-

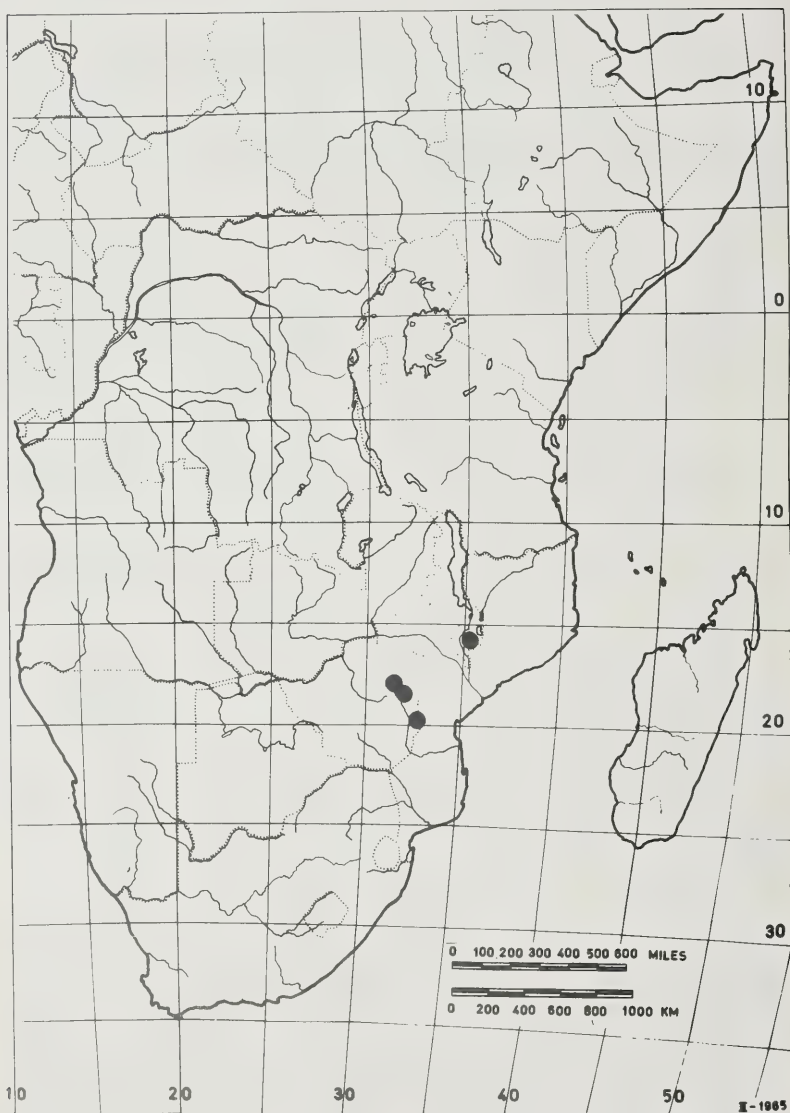


FIG. 8.
Distribution of *B. maculata*.

berton, *Culver* 49 (B†, syntype), Barberton, *Galpin* 1229 (B†, syntype; PRE!, Z!).

Icon: *Icones Orch. Austro-Afr.* 1: t.43 (1896).

Flowers small (lateral sepal 2–5 mm long); spur sharply decurved, 3–5 mm long; inflorescence a dense spike; leaves narrowly lanceolate to rarely lanceolate.

Tubers 15–30 mm long and 10–25 mm in diameter, hirsute. *Plant* 200–600 mm tall, erect, occasionally with fibrous leaf remains at the base; basal sheaths two, the outer up to 30 mm long, often lost; the inner 40–120 mm long, muricate or scabrid. *Leaves* (2–)3(–5), the leaf base sheathing, the blade narrowly lanceolate to rarely lanceolate, semi-erect, very acute to acuminate, the longest leaf at the base, 80–200 mm long and 8–16(–25) mm wide, the leaves grading apically into the floral bracts, the midrib and often the side veins prominent below. *Inflorescence* slender cylindrical, densely 20–60-flowered, 40–120 mm long; ovary (5–)7–8(–10) mm long; bracts narrowly lanceolate to lanceolate, acuminate, erect, taller to very much taller than the flowers and more or less prominent; flowers c. 4 mm in diameter, often facing down, white with a slight green or brown tint. *Dorsal sepal* erect, falcate in side view, ovate, acuminate, galea (2–)3–5 mm tall, 1,5–2 mm wide and 0,8–1 mm deep; spur from a horizontal base, cylindrical, soon sharply decurved, frequently clavate, 3–5 mm long, 0,5–1 mm in diameter at the base and 0,5–2 mm in diameter at the apex. *Lateral sepals* oblique, oblong, acute, spreading forwards, flat with the apical margins somewhat incurved, the bases of the lateral sepals frequently fused, (2–)3–5 mm long and (1–)1,5–2,5 mm wide. *Petals* oblong to almost square in outline, obliquely acute, the nerve falcate, (1,5–)2,5–3,5 mm tall and 1,5–2,5 mm wide. *Lip* minute, 0,5–1 mm long. *Rostellum* c. 1 mm tall, lateral lobes well developed, concave, bearing the viscidia, staminodes half as tall to as tall as the lateral lobes; anther horizontal or somewhat erect, c. 0,8 mm long; stigma shortly stipitate, almost horizontal. (Fig. 9).

The nomenclatural confusion created by the description of a separate species for each geographic area in which this widespread species occurs, and even the description of several species in the same area by taxonomists such as Kraenzlin and Schlechter in his old age, has been mostly clarified by Summerhayes (1966). Summerhayes did not take the Madagascan species into account.

B. parviflora was described by Lindley from a specimen collected at the southern extreme of the distribution range of this species. It is therefore scarcely surprising that Hooker described the collection from the Cameroons as a new species. However, Kraenzlin's description of *D. preussii* is surprising. It appears as if he completely misunderstood the floral structure of the species, as he compared his new species to *Disa polygonoides* and *D. welwitschii*—both species from *Disa* Sect. *Micranthae*.

The type of *D. apetala* is lost. Kraenzlin noted that the specimen was without

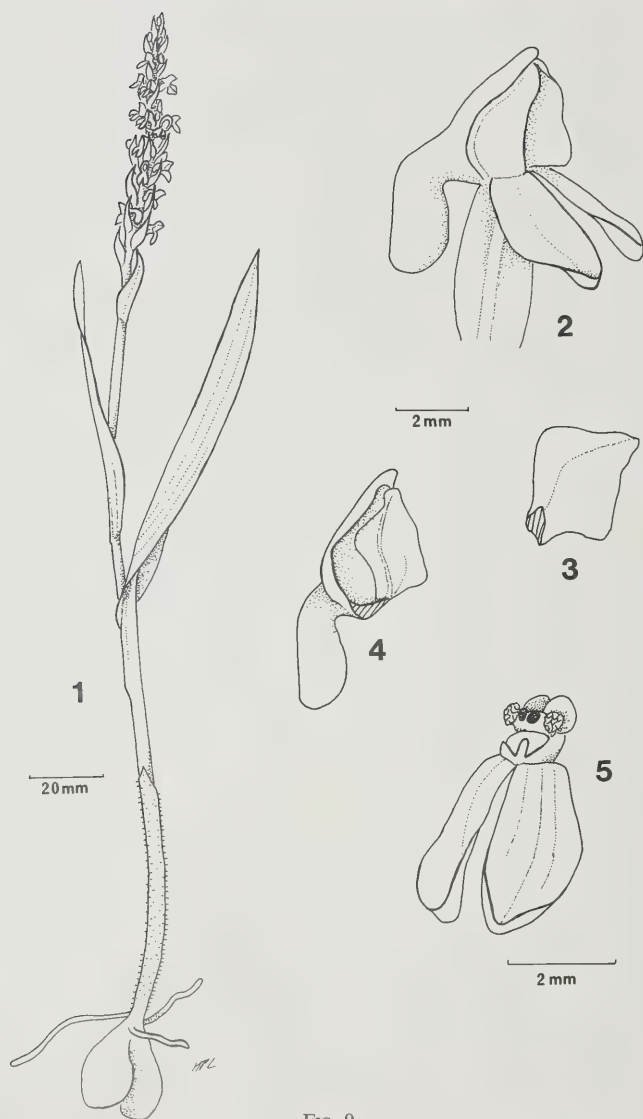


FIG. 9.

B. parviflora. 1. Whole plant (Linder 2074). 2-5. Floral detail (Wild 4472); 2. Whole flower; 3. Petal in two dimensions; 4. Petal and dorsal sepal; 5. Lateral sepals, lip and column.

petals, and suggested that the petals might be fused to the lateral sepals. From the description of the sepals and the spur it is clear that this name is applicable to *B. parviflora*.

Bolus (1889), Kraenzlin (1900), Schlechter (1901) and Rolfe (1913) kept *B. parviflora* distinct from the tropical names, although Schlechter noted that they are very closely allied, and separated by the more slender habit and cylindrical spurs of the tropical species.

Brown (1898) united *B. alpina* and *D. preussii*, but kept *B. apetalata* distinct. Schlechter (1901) united all three species. Kraenzlin (1900) retained *Disa apetalata*; it appears as though he did not understand the concept of *Brownleea* at all. The last tropical species to be described was *B. gracilis*, which Schlechter compared to *B. apetalata*. Schlechter also described *B. transvaalensis* from South Africa. The type is indistinguishable from *B. parviflora*. In 1924 Schlechter described *B. perrieri* from Madagascar. Although he mentioned the affinity of his new species with *B. parviflora*, he did not indicate whether he considered the affinity to be close. It appears as if Schlechter developed a rather narrow species concept in his later years.

VARIATION

As could be expected of such a widespread species, *B. parviflora* shows extensive variation. In the past, insufficient material obscured the continuity in the variation and this led to the description of numerous species.

The spur varies from strongly clavate to slender. Only the slender form has been recorded from the Cameroons (although not much material is available from this area). In East and South-central Africa subclavate spurs do occur. Strongly clavate spurs (spur 1.5–2 mm in diameter at the apex) are only recorded from South Africa (i.e. McLoughlin 63). Material from the same plant can frequently show a remarkable range of variation, and the complete range from clavate to slender spurs can be found in a single population in South Africa.

In general the spur is sharply decurved, but occasionally it is only gently decurved. This latter form is relatively more frequent in tropical Africa than in South Africa.

The lateral sepals are in some cases more or less adnate to one another near the base. This character state is the most frequent in tropical Africa, and very rare in South Africa (i.e. Flanagan 2254). The floral bracts are always longer than the flower, but usually only just overtopping the flowers. In the Rungwe-Isoka area of Tanzania, the bracts are very prominent, up to twice as long or even longer than the ovary, and erect (i.e. the type of *B. gracilis* Schltr.). Intermediate forms are widespread, and occasional forms with long bracts occur in South Africa.

The general robustness of the plant is variable. The leaf width can vary from 10 mm to 30 mm, and the inflorescences from slender (i.e. material from the

Cameroun Mountains, less than 10 mm in diameter) to very densely flowered, cylindrical and robust (i.e. in South Africa, more than 20 mm in diameter).

None of the characters show clear geographic segregation, but whether even detailed population studies would find a basis for the separation of geographical subspecies is doubtful.

ECOLOGY AND PHYTOGEOGRAPHY

This widespread species occurs throughout the Afro-montane Region as defined by White (1978) from southern Tanzania southwards, with outliers on the Cameroun Mountains and on Mt. Nyira in the Northern Frontier Province of Kenya. It also occurs in the montane zone in Madagascar.

Over the whole range the species has been recorded from secondary mountain grassland, sometimes from grassland among the rocks (*Hilliard & Burt* 1970) or from damp grassland. From the little data available, it appears as if the habitat in Madagascar might be different. *Perrier de la Bâthie* (11882) noted that the species grew in rocky areas among *Philippia* bushes, in the altitude range from 1 400 to 2 200 m. This zone is comparable with the Afro-montane zone in Africa (*vide* Koechlin, 1972).

The climate over the range of *B. parviflora* is generally temperate, with rare or no snowfalls. The rain falls mostly in summer, and rainfall ranges from about 1 000 mm p.a. in the southern part of the range, to probably over 2 000 mm p.a. in the Cameroun Mountains (Jackson, 1961). In southern Tanzania the rainfall is c. 1 700 mm p.a., the bulk of which falls between December and April (Kerfoot, 1964). On the Nyika plateau the rainfall varies from c. 1 000 mm to 2 300 mm p.a., depending on the locality (Chapman & White, 1970). In Malawi and Tanzania mists frequently occur in the summer months. In South Africa mists are rare (Killick, 1963).

The flowering time of this species is generally in March, with occasional flowering specimens collected in February or April. Towards the north the flowering time tends to be later.

REPRESENTATIVE COLLECTIONS

Madagascar, Rocailles de la Manondana, fleurs roses, IV.1912, *Perrier de la Bâthie* 11882 (P); Tanzania, Mbeya mountain, bog by stream, upland grassland, 2 340 m, dorsal sepal very pale greenish mauve, petals and labellum almost white, 13.V.1956, *Milne-Redhead & Taylor* 10326 (K); Malawi, Nyika, Kasaramba road, 2 400 m, grassland, flowers purple, 28.III.1970, *Pawek* 3392 (K); Zambia, Nyika Plateau, grassland, III.1967, *Williamson & Odgers* 297 (SRGH, K); Zimbabwe, Umtali, Himalaya Range, Engwa Peak, 2 100 m, sparse grassland, flowers white, 3.III.1954, *Wild* 4482 (SRGH, K); Transvaal, Carolina to Lydenburg, sandy soil, grassland, 11.III.1939, *Dyer* 3851 (PRE, K); Cape,

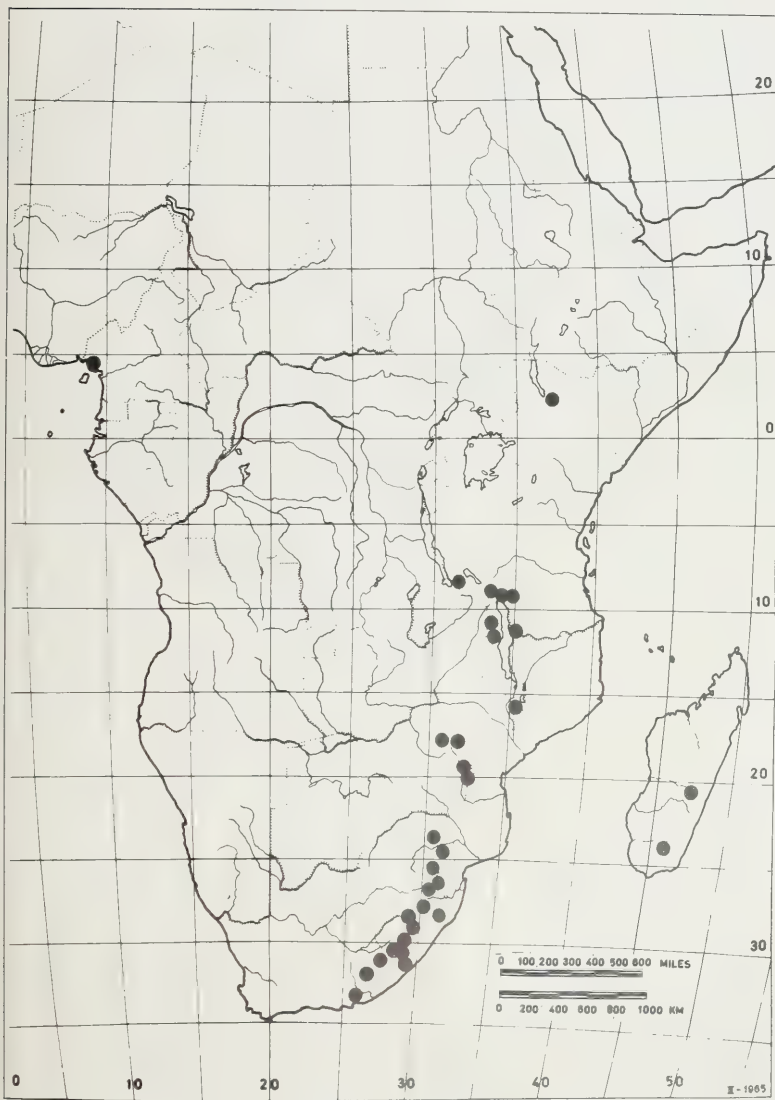


FIG. 10.
Distribution of *B. parviflora*.

Somerset East, upper slopes of Boschberg, III.1869, *MacOwan 1530* (BOL, BM, PRE, K, SAM, Z, ZT, W).

6. *Brownleea galpinii* Bolus, *Icones Orch. Austro-Afr.* 1: t.42 (1893). Type: Natal, banks of streams near Kokstad, alt. 1 540 m, March, *Tyson 1084* (BOL!, syntype; K!, SAM!, GRA!), Transvaal, between Barberton and Swaziland, 1 400 m, March, *Galpin 1255* (BOL!, syntype; K!, Z!, PRE!, SAM!). *Galpin 1255* (BOL) is here selected as the lectotype.

Brownleea flavescens Schltr. in *Ann. Transv. Mus.* 10: 249 (1924). Type: Eastern Transvaal, in marshes in Houtboschberg, February 1894, *Schlechter 4391* (B†, holotype; BOL!, GRA!, K!, PRE!, BM!, G!, Z!, W!, BR!).

Icon: Bolus, *Icones Orch. Austro-Afr.* 1: t.42 (1893).

Flowers aggregated in dense capitate inflorescences; spurs almost straight, 3–6 mm long; petals oblong-pandurate with expanded crenate upper margins.

Tubers usually more or less globular, 10–20 mm in diameter, villous. *Plant* occasionally subflexuose, 150–300–500 mm tall; basal sheaths often two, the inner 50–100(–140) mm long, acute, ribbed, pale brown, often more or less mottled with small mucronate patches. *Leaves* 2(–4), usually scattered on the upper half of the stem, erect to semi-erect, linear, the leaf base sheathing, the blade very acute, subconduplicate, the lowest leaf 60–200 mm long and 5–15 mm wide with prominent ribs, the upper leaf much smaller than the lower leaf. *Inflorescence* capitate, often secund, 15–45 mm long and 10–30 mm in diameter, 5–25-flowered; bracts lanceolate, acuminate, somewhat longer than the ovary; ovary c. 10 mm long; flowers facing out horizontally, c. 5 mm in diameter, white to cream, the petals frequently with small purplish spots on the “fan”. *Dorsal sepal* galeate, erect, narrowly ovate to lanceolate, falcate in side view, acuminate, galea 5–10 mm tall and c. 2 mm deep; spur slender cylindrical obtuse, 3.5–4.8–6 mm long, parallel to the ovary, straight. *Lateral sepals* suboblique, narrowly elliptical, acute, spreading forwards, flat, the apex often down-curved, 6–7.4–10 mm long and 2–4 mm wide. *Petals* almost as tall as the dorsal sepal, narrowly oblong-pandurate in outline, the basal anticus lobe flanking the stigma and the apical lobe spreading fan-like, variable in size and crenulation and up to 4 mm wide. *Lip* minute, erect, 0.8–2.5 mm long, linear. *Rostellum* erect, c. 3 mm tall, the lateral lobes narrowly oblong and shallowly grooved, central lobe subobsolete, staminodes c. 1 mm in diameter; anther horizontal at the base, then upcurved so that the apex frequently touches the rostellum; stigma vertical, sessile at the base of the rostellum.

TAXONOMIC NOTES

When Bolus described *Brownleea galpinii*, he also described a var. *major*, which he differentiated from the typical variety by: “floribus plus quam quarta parte majoribus; petalis latioribus apice rotundatis, magis lobatis concavisque;

labello duplo longiore". This was accepted by subsequent authors, until Schlechter raised the variety to specific level in 1924.

Unfortunately only some 30 collections of *B. galpinii* were available for study, and field studies have only been conducted on one of the subspecies (*B. galpinii* ssp. *major*). Analysis of the available material revealed that the two putative taxa show some size segregation (length of the lateral sepals, see Fig. 11) in the flowers, and that the lip is twice as long in the ssp. *major*. Remark-

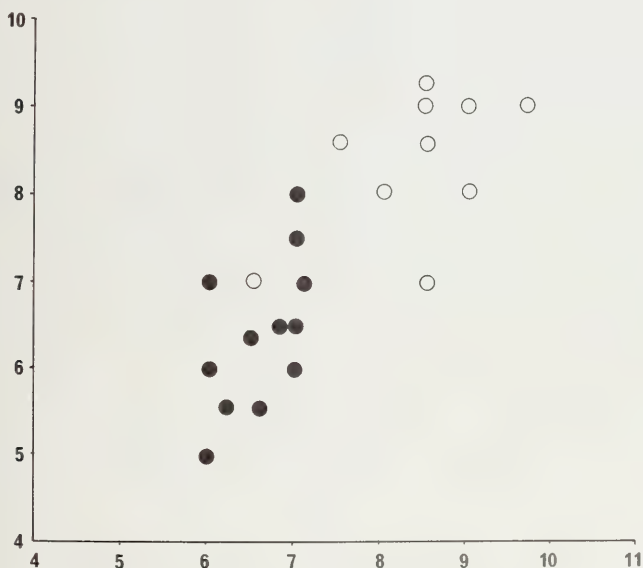


FIG. 11.

Variation in lateral sepal length and lip length in *B. galpinii*. Open circles represent *B. galpinii* ssp. *major*, and solid circles *B. galpinii* ssp. *galpinii*.

ably, spur length remains almost constant throughout the species. Petal shape variation is correlated with lip and flower size variation, but is difficult to quantify. In the ssp. *major*, the apical lobe of the petal is more expanded and the margin is more crenulate than in the typical subspecies.

The two collections from Mt. Marwaga in Natal (2929-DC) (*O'Connor* 344 and *Rennie* 348) indicate that populations on this mountain might be intermediate between the two subspecies.

The two subspecies are allopatric, with ssp. *galpinii* extending from East Griqualand to Inyanga in Zimbabwe, and ssp. *major* restricted to the Drakensberg in Natal and Lesotho. Along the contact zone, ssp. *major* appears to occur at higher altitudes than ssp. *galpinii*.

These two taxa therefore appear to be eco-geographic subspecies, with some morphological differentiation.

6a. *Brownleea galpinii* Bolus ssp. *galpinii*

Flowers smaller, lateral sepals 6–7 mm long and dorsal sepal 5–8 mm long; petals with the upper margin not or slightly crenulate; lip erect, 0.8–1.3 mm long, not reaching the top of the stigma.

The one syntype of *B. galpinii* (Tyson 1084) is from the southern extreme of the distribution range of this subspecies.

B. flavescens was described from Schlechter 4391, which was collected from near the centre of the distribution range of *B. galpinii* ssp. *galpinii*. Schlechter (1924b) differentiated it from *B. galpinii* and *B. leucantha* (= *B. galpinii* ssp. *major*) on the basis of its having three leaves (which not all individuals in the collection have), "oblogoid" inflorescences (the meaning of this term is not clear), smaller flowers, narrower petals and a shorter spur. The latter characters fit *B. galpinii* ssp. *galpinii*. There is no doubt that the species has to be included in *B. galpinii* ssp. *galpinii*.

ECOLOGY AND PHYTOGEOGRAPHY

This subspecies occurs in the escarpment mountains from Zimbabwe to the Van Reenen gap between the Natal and Transvaal Drakensberg. From there it extends into the Natal uplands to East Griqualand. In this latter area it appears to be quite rare.

The distribution area could be described as montane, with a more or less temperate climate and with snow only occurring rarely. The rainfall occurs mainly in summer, and is about 1 000 mm p.a. The altitude at which the subspecies occurs increases from 1 540 m in the south at Kokstad to 1 300–2 200 m in the Eastern Transvaal to up to 2 500 m in Zimbabwe.

In general this taxon has been recorded from damp grassland, stream banks or seepages, although there are some records from rocky areas (Jacobson 3806, from Inyanga in Zimbabwe and Davidson 3120 from rock crevices on Wolkberg in the Eastern Transvaal).

Flowering occurs in March and April, with a few records of flowering as early as February.

REPRESENTATIVE COLLECTIONS

Transvaal, Bosch's near Barberton, 1 350 m, flowers white, III.1891, *Galpin* 1255 (SAM, BOL, PRE); Natal, Ngome, above forest, damp grassland, 1 200 m

flowers pure white, 2.IV.1977, *Hilliard & Burt* 9938 (NU); Zimbabwe, summit of Mt. Inyangani, 2 400 m, flowers white, 14.II.1931, *Norlindh & Weimarck* 5001 (K, SRGH, S, BR).

6b. *Brownleea galpinii* Bolus ssp. *major* (Bolus) Linder, stat. nov.

Basionym: *Brownleea galpinii* Bolus var. *major* Bolus, *Icones Orch. Austro-Afr.* 1: t.42 (1893). Type: Natal, south side of Mount Currie, near Kokstad, March, *Tyson* 1074 (BOL!, holotype).

Brownleea fanniniae Rolfe in *Kew Bull.* 1920: 131 (1920). Type: Natal, Dargle Farm, *Mrs Fannin* 98 (TCD!, holotype).

Brownleea leucantha Schltr. in *Ann. Transv. Mus.* 10: 249 (1924b). Type: As for *B. galpinii* Bolus var. *major* Bolus.

Icon: Bolus, *Icones Orch. Austro-Afr.* 1: t.42 (1893).

Flowers large, lateral sepals (6,5–)8–10 mm long. and dorsal sepal 7,5–9 mm long; petals with the apical lobe crenulate and fan-like; lip 2–2,6 mm long, reaching over the stigma to between the rostellum lobes. (Fig. 12).

When Bolus described *B. galpinii* in 1893, he also described the var. *major*, and commented: "The variety *major* looks at first sight different, but there are too many points of identity to justify specific distinction." This view is still valid.

Rolfe (1920) noted about *B. fanniniae* that "*B. galpinii* . . . must be very nearly allied, but I have not seen a specimen". Reference to *Flora Capensis* shows that this must refer to *B. galpinii* var. *major*, as he had cited as having seen material of var. *galpinii*. The type sheet holds two very well-preserved specimens of this rather beautiful species.

In 1924 Schlechter raised *B. galpinii* var. *major* to specific status, and named it *B. leucantha*. For reasons given above, this view is not held here.

ECOLOGY AND PHYTOGEOGRAPHY

This subspecies is restricted to the Sub-Alpine belt (*vide* Killick, 1963) of the Natal Drakensberg, from Matatiele in the south to Mont-aux-Sources in the north.

The altitudinal range of the subspecies is from 1 800 m to about 2 500 m. In this zone this taxon occurs in grassland or in open *Protea* savanna, in basaltic or sandstone derived soil (Killick, 1963; West, 1951). The climate is cold temperate, with snowfalls in winter. The rainfall in the Cathedral Peak area ranges from 1 400 mm at the lower altitudes to almost 2 000 mm at the upper altitudes (Killick, 1963). The rain falls mainly in the summer months, when fog also frequently occurs.

In damp areas this species tends to form fairly sparse to almost dense populations. Field studies in the Mont-aux-Sources area showed that the subspecies extended from 1 800 m to 2 500 m, and tended to form small populations in damp seepage areas. At higher altitudes where the grassland was seasonally wet-

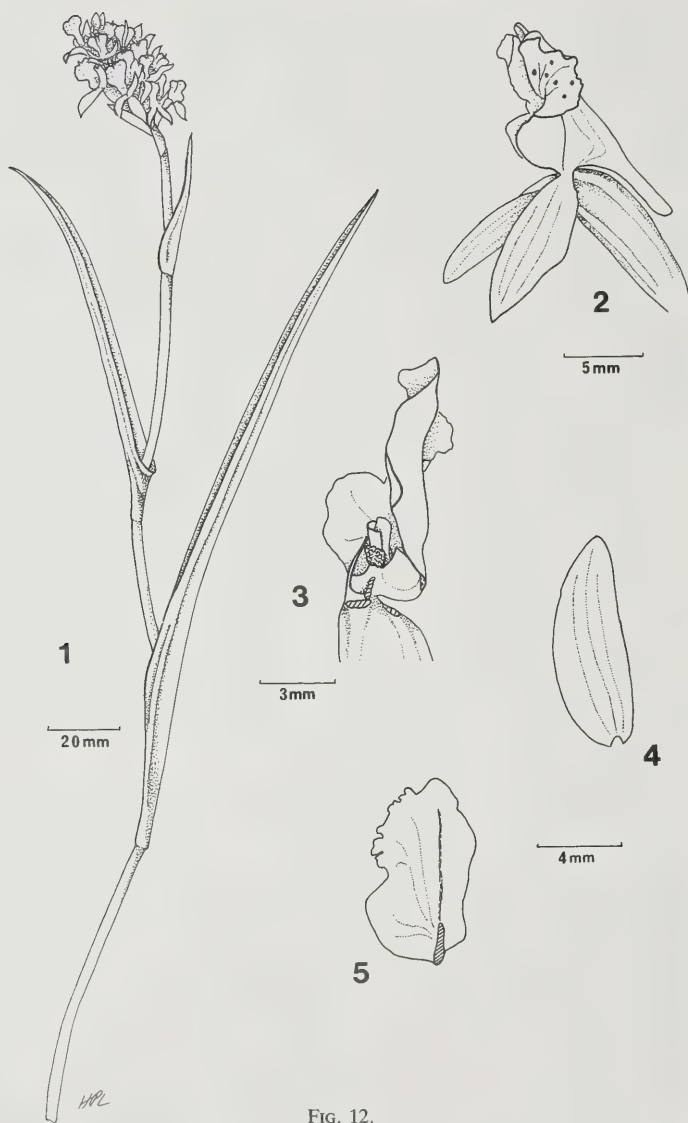


FIG. 12.

B. galpinii ssp. *major*. 1. Whole plant (Linder 2073). 2-5. Floral detail (Fannin 98); 2. Whole flower; 3. Petal, lip and column; 4. Lateral sepal (flattened); 5. Petal (flattened).

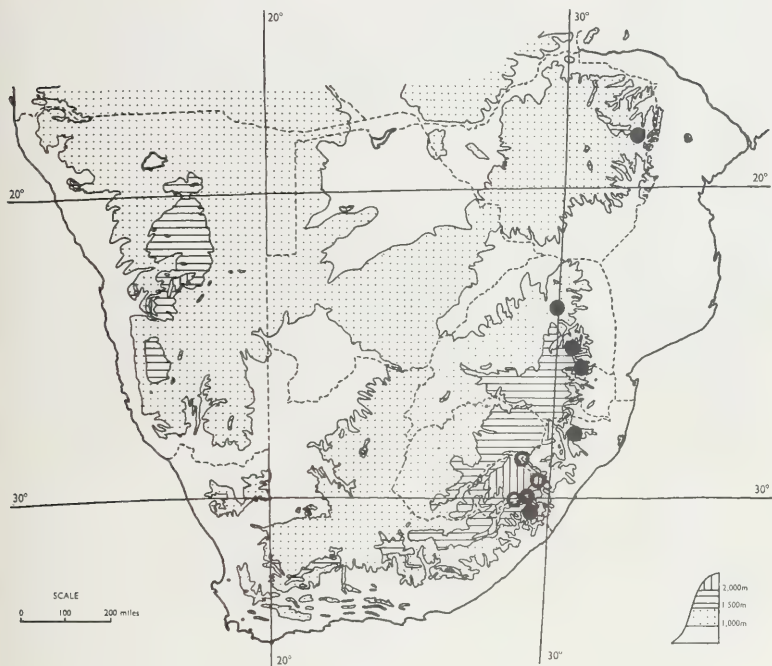


FIG. 13.

Distribution of *B. galpinii*. Open circles represent *B. galpinii* ssp. *major* and solid circles represent ssp. *galpinii*.

ter, populations tended to be extensive. The same tendencies were observed in the Sehlabathebe National Park, Lesotho.

Flowering occurs from the end of January to March.

REPRESENTATIVE COLLECTIONS

Lesotho, Sehlabathebe, near summit of Bushmansnek Pass, c. 2 500 m, flowers pure white, petals with a couple of purplish spots on the "fan"; no detectable scent, locally common in damp grassland, 27.II.1979, *Linder 2093* (BOL); Natal, Mont-aux-Sources, 2 400 m, damp seepage areas, labellum and sepals creamy white, 4.III.1977, *Rourke 1534* (BOL).

SPECIES EXCLUDED

Brownleea pentherana Kraenzl. in Ann. Nat. Hofmus. Wien **20**: 6 (1905).
Type: Montagu Pass. 2.XI.1894, *Penther 189* (W!, holotype).

This is a synonym of *Monadenia ophrydea* Lindl. in Gen. Sp. Orch. 358 (1838).

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APPENDIX 1. LIST OF SPECIMENS STUDIED

The specimens are listed alphabetically according to the name of the collector. The figures in brackets refer to the number of the taxon in the text. Herbaria from which each collection has been studied are indicated by the letter codes of Holmgren and Keuken (1974). Hybrid collections are indicated by combinations such as (2–5).

Acocals 22072 (5) PRE—Adamson 434 (5) BM, K—Alleizette 621 (2) P—Allen 526 (5) K; 528 (4) K—Atherstone 30 (2) K.

Ball 47 (4) SRGH; 283 (5) SRGH; 1028 (5) SRGH; 1029 (5) SRGH; in SRGH 50961 (4) K—Barber (2) Z; (5) K—Baron 1751 (2) K; (2) K—Baur 625 (3) BOL, K; 638 (2) G—Bayer & McClean 285 (1) PRE—Beasley 52 (6a) K, SRGH; 73 (5) SRGH; 74 (6a) K, SRGH—Benson 1263 (5) K—Bernardi 8915 (2) G, K—Beverley 493 (1) NU—Beverley & Hoener 623 (6b) NU; 679 (5) NU—Boardman 42 (5) PRE; 260 (5) PRE; 273 (5) BOL—Bokelmann (1) BOL—Bolus 10295 (5) BOL; 10296 (5) BOL—Bos er 11085 (2) P; 10312 (2) P; 19507 (5) P—Bredenkamp 783 (5) PRE—Brooke 51 (5) BM—Brownlee (2) K; (5) K; in Tyson 2918 (2) SAM—Buchanan (5) K—Button 58 (5) NU.

Chase 217 (4) SRGH; 6013 (5) K, SRGH; 4069 (5) SRGH; 4494 (4) SRGH—Codd 9314 (2) PRE—Compton 21636 (2) NBG, PRE; 25811 (2) NBG, PRE; 26730 (2) NBG, PRE; 28560 (2) NBG—Cribb & Grey-Wilson 10823 (5) K—Culver (2) K—Cuthbert 32 (5) K—Davidson 3120 (6a) BOL—Decary 13321 (2) P—De Souza 533 (2) PRE—Devenish 1314 (5) G, K, PRE—Dieterlen 765 (5) K, P, PRE, SAM, Z; 906 (1) PRE—Doe 17 (3) BOL; 24 (2) BOL; in BOL 23637 (1) BOL; (3) BOL—Doidge 4797 (5) K—Drège (1) G;

(3) SAM; (5) G—Drewe 11 (5) K—Drummond 9130 (4) SRGH; 9143 (5) SRGH; 9161 (5) SRGH—Dusein 438 (5) S—Dyer 3951 (5) K, PRE.

Ecklon & Zeyher (5) P, S—Edwards 4302 (2) K, PRE—Esterhuysen 16856 (3) BOL; 27149 (3) PRE; (3) NBG.

Ferrar 3984 (5) PRE, SRGH—Flanagan 529 (2) PRE, SAM, Z; 2254 (5) K, PRE; 2254a (3) K; 2256 (3) P, PRE, SAM, W; 2549 (5) P; 2876 (5) PRE—Fourcade 554 (3) BOL—Fox 3 (2) K—Francois (2) P—Fuller 107 (5) K; 133 (5) K.

Galpin 1229 (5) PRE, Z; 1255 (6a) BOL, PRE, SAM; 1257 (2) PRE; 1506 (5) PRE; 2056 (3) PRE; 6839 (1) PRE; 6840 (3) BOL, K, PRE; 8182 (5) K; (6a) BOL—Germishuizen 45 (2) PRE—Gilliland 1895 (6a) BM, K; 1899 (5) K—Glass 521 (5) Z; 893 (1) SAM; in MacOwan & Bolus 1377 (3) BM, BOL, K, SAM, UPS, W—Gower (5) PRE—Grewcock in PRE 20151 (2) PRE—Grice (5) NU; (6b) NU—Grosvenor 834 (5) SRGH—Grosvenor & Renz 1195 (5) SRGH; 1331 (5) SRGH—Guillarmod 1143 (1) PRE.

Hamilton (2) PRE—Harrison in BOL 25769 (2) BOL—Harvey 22 (2) K; 107 (2) K; (2) BOL—Hilliard 2749 (2) NU; 8116 (5) NU—Hilliard & Burtt 6508 (3) K, NU, PRE; 6630 (1) K, NU; 9938 (6a) NU; 9970 (5) BOL, NU—Holland in BOL 23638 (2) BOL—Humbert 15073 (5) P; 15101 (5) P; 20883 (2) P—Hutton (2) K; (2) K; (3) K, Z; (5) K, S.

Jackson 2182 (5) K—Jacobsen 2655 (2) PRE; 3799 (5) K, PRE, SRGH; 3806 (6a) K, PRE, SRGH—Jacobsz 577 (5) PRE; 2114 (5) NBG; 2586 (5) PRE; (5) BOL—Jacot Guillarmod 2503 (1) PRE; 4018 (1) PRE—Jacottet 67 (5) Z—Jeppe in PRE 33351 (3) PRE—Johnston 86 (5) BM, K; (2) NBG—Jones 68 (5) SRGH—Junod 1209 (5) G; (5) G.

Kerfoot 2100 (5) K—Killick 1905 (5) PRE; 2319 (1) BM, K, PRE; 3920 (2) PRE—Krook 90 (5) W.

Laughton 163 (3) BOL—Leipoldt (3) BOL—Levey 2822 (2) PRE—Linder 912 (1) BOL; 949 (1) BOL; 1008 (1) BOL; 1017 (1) BOL; 1042 (1) BOL; 1051 (1) BOL; 1055 (1) BOL; 1067 (1) BOL; 1072 (1) BOL; 1079 (1) BOL; 1767 (3) BOL; 2051 (2) BOL; 2072 (6b) BOL; 2073 (6b) BOL; 2074 (5) BOL; 2075 (1) BOL; 2093 (6b) BOL; 2094 (3) BOL; 2110 (3) BOL; 2111 (1) BOL.

MacInnes 215 (5) K—MacOwan 232 (2) BOL, K, S, SAM, W, Z; 526 (3) BOL, BM, G, K, SAM, W, Z, ZT; 1530 (5) BM, BOL, K, PRE, SAM, W, Z, ZT—MacOwan & Bolus 1377 (3) BM, BOL, G, K, P, SAM, UPS, W, ZT—Mann 2120 (5) K—Marloth 6027 (3) PRE—McChan 253 (5) PRE—McCloughlan 10 (5) BOL; 23 (5) BOL; 63 in PRE 12755 (5) PRE; 68 in PRE 12757 (2) BOL, PRE; 194 (1) BOL; 195 (6b) BOL; 205 (3) BOL; 211 (5) BOL; 223 (5) BOL; 531 (5) BOL, PRE; in BOL 16403 (1) BOL; (3) BOL; (5) PRE; (5) BOL; (5) PRE—Meikle (4) SRGH—Milford 701 (1) K—Milne-Redhead & Taylor 10326 (5) K; 10390 (5) K—Meuller 2662 (4) SRGH.

Newdigate 252 (3) BOL—Newton & Whitmore 403 (4) BM—Nicholson 1528 (2) PRE; 1529 (2) PRE—Norlindh & Weimarck 5001 (6a) BR, K, S, SRGH.

O'Connor 344 (5) NU; 344 (6b) NU; 369 (2) NU.

Pappe (2) K, SAM; in SAM 27428 (5) SAM—Pawek 2197 (5) K; 3392 (5) K; 4646 (5) K; 9284 (5) K; Pegler 820 (2) PRE, SAM; 2056 (5) PRE—Pegler & Kolbe (3) BOL—Peltier 2187 (2) P; 5363 (2) P; 5405 (2) P—Perrier de la Bâthie 11882 (5) P; 13505 (2) P; 13701 (2) P; 14713 (2) P—Physick 45 (6b) NU—Plowes 2852 (4) SRGH—Potter 1799 (5) PRE—Preuss 973 (3) K.

Rand 1201 (5) BM—Ranger 20 (2) PRE—Rehman 2850 (2) Z; (3) Z—Rennie 348 (6a) NU; 820 (6b) NU—Richards 13791 (5) BR, K—Richardson 102 (6a) NU; 104 (5) NU—Robinson 4477 (5) K—Rogers 18813 (2) Z—Rourke 1534 (6b) BOL—Rudatis 1357 (2) BM, G, K, P, PRE, W, Z—Rutgers 13 (5) BOL.

Schelpel 1425 (6b) NU; in NBG 361/56 (2) NBG—Schlechter 2540 (5) PRE; 4391 (6a) BM, BOL, BR, G, GRA, K, W, Z; 4711 (5) K, Z; 6942 (5) Z—Schlieben 907 (5) BR, G, Z—Schofield (5) NU—Schweikerdt in PRE 31851 (5) PRE—Scott-Elliot 483 (3) BM; 913 (2) BM, K—Scully 411 (2) Z—Semsei 1680 (5) K—Sidey 1602 (5) PRE, S—Sim 14 (2) BOL; 21 (3) Z; 23 (3) BOL; 257 (5) PRE; 869 (5) NU; 870 (2) NU; 2979 (5) NBG; (3) NBG—Simon & Kelly 1851 (4) BOL. SRGH—St. Clair Thompson 795 (5) K; 907 (5) K; 914 (5) K—Steward 2054 (5) NU—Stirton 1762 (2) PRE; 1773 (5) PRE; 1816 (2) K.

PRE—Stolz 1178 (5) K; 1981 (5) K; 2580 (5) BM, BR, C, G, K, P, PRE, S, W, Z—Strey 2989 (2) K, PRE; 3707 (2) PRE; 6503 (2) PRE; 7425 (2) PRE—Symons 418 (1) PRE.

Thode 52 (1) K—Thorncroft 1453 (5) K, PRE; (2) K, PRE—Trauseld 242 (6b) PRE, NU; 347 (5) NU, PRE; 992 (5) PRE—Tyson 1074 (6b) BOL; 1080 (5) BOL, K, SAM; 1084 (6a) BOL, GRA, K, SAM; 2066 (5) K, PRE, SAM, Z; 2680 (5) PRE.

Van der Merwe 1293 (5) PRE—Vet. Officer (3) PRE.

Wall 43 (3) S—Waterlot 789 (2) P; (2) P—Weale 931 (5) BM, W—Weiste (4) SRGH—Whellan 1249 (4) SRGH—Whitworth (3) BOL—Widdicombe 17 (2) BOL; 18 (3) BOL; (5) BOL—Wild 2913 (4) K, SRGH; 4472 (5) K, SRGH; 4482 (5) K, SRGH; 4523 (5) K, SRGH; 5477 (6a) K, SRGH; 5713 (5) BOL, K, SRGH; 6230 (4) BOL, K, SRGH—Williams in PRE 10513 (2) PRE—Williamson & Odgers 294 (5) K, SRGH—Williamson, Ball & Simon 900 (5) SRGH—Wood 971 (5) BM; 1982 (2) K; 3177 (3) K; 3179 (2) K; 7501 (2) BM, PRE; 9278 (6b) GRA, PRE; 9335 (2) G—Wright 1455 (5) NU; 2184 (6b) NU—Wylie in Wood 7501 (2) BM, PRE.